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(54) IMPROVED REACTIVE PIPE JOINT

(71) We, REDLAND PIPES LIMITED, a British Company of Redland House, Castle Gate, Reigate, Surrey, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a reactive pipe joint for providing a fluid-tight joint (e.g. gas-tight or liquid-tight) in an annular recess defined by a widening at one end of an annular gap located between relatively movable male and female "cylindraceous" (as hereinafter defined) pipe ends, the joint utilising an annular seal of elastomeric material disposed within the recess and sealingly contacting both the pipe ends.

Throughout this specification the term "cylindraceous" should be understood to mean cylinders of circular or near-circular cross-section as well as slightly tapering frusto-conical surfaces of circular or near circular cross-section.

Cylindraceous pipe ends will all have an axis of symmetry which is hereinafter referred to simply as "the axis".

The term "reactive" means that the seal is effected between the pipe ends in response to fluid pressure in the recess and not by the use of screwed-in gland rings or the like used to pre-compress the sealing assembly.

Where a reactive pipe joint is used to resist the leakage of fluid from the joint between pipe lengths under high pressure, there is a risk of the annular seal being at least in part extruded from the recess, an occurrence which will damage the seal and may even cause failure of the fluid-tight joint. The less deformable is the annular seal, the less likely is the risk of extrusion from the recess but the less effective becomes the seal and the less able is it to accommodate inaccuracies in the shaping and/or sizing of the cylindraceous members. It is possible to design the cylindraceous pipe ends so that the gap immediately adjacent to where it widens to form the recess is always small enough to prevent extrusion of the annular seal out of the recess, but this solution to the problem is undesirable in that it increases the manufacturing cost of the pipe lengths or it requires uneconomic selection of matched pairs of pipe lengths.

Proposals have been made for inhibiting extrusion of the annular seal from the recess under high-pressure conditions by means of a second seal component which is designed to close the gap. This invention is concerned with a pipe joint of this general type.

According to one aspect of the invention there is provided a reactive (as hereinbefore defined) pipe joint providing a fluid-tight joint in an annular recess defined by a widening of an annular gap located between relatively movable male and female "cylindraceous" (as hereinbefore defined) pipe ends, the outer end of the gap communicating with the space outside the pipe and the recess end of the gap communicating with the bore of the pipe, the joint utilising a seal comprising first and second discrete components, the first component being an annular seal of elastomeric material disposed within the recess and sealingly contacting both the pipe ends, the second seal component being utilised in the recess intermediate the annular seal and an end wall of the recess on the male pipe end which end wall provides said widening of the gap, the second seal component being of a material which is harder than the annular seal and being capable of radial expansion within the recess under the influence of rising pressure in the pipe, the end wall of the recess being inclined to the plane which is perpendicular to the axis of the male pipe end and which passes through the outermost extremity of the recess, the inclination being in the direction such that the entire end wall lies on the recess side of the said plane, whereby radial expansion of the second seal component will arise on a sufficient pressure rise in the pipe by virtue of said second seal component riding up said inclined end wall.

By employing a second seal component which is capable of radial expansion and which bears against the end wall of the recess inclined in the manner described, pressure generated within the recess on the side of the annular seal which is remote from the second seal component, will cause the latter to expand to close the recess from the rest of the gap so that the annular seal effects its sealing by contacting the second seal component and the two members with no risk of its being extruded from the recess.

Suitably the end wall of the recess is a frusto-conical surface inclined at an angle of between 5° and 60° to the said perpendicular plane. Angles of between 10 and 35° are preferred, angles in the range 20 to 30° being particularly suitable.

Suitably the second seal component is a ring of generally triangular cross-section and hard elastomers (such as filled rubber which may or may not be reinforced with wires or threads), are preferred. Since the second seal component is required to expand radially within the recess as a result of its engagement with the end wall of the recess, it is convenient to ensure a relatively low coefficient of friction exists between the second seal component and the end wall and this may conveniently be provided by wrapping the second seal component in a coating of a low friction coefficient material.

The annular seal is suitably an O-ring of conventional type.

The invention will now be further described, by way of example, with reference to the accompanying drawings, in which:—

Figures 1 and 2 show a sealing assembly in accordance with the invention as applied to mating ends of two plastics pipe lengths Figure 1 showing the sealing assembly partially made and Figure 2 showing the sealing assembly fully made and subjected to full operating pressure,

Figure 3 is a cross-sectional view of a preferred form of second seal component for employment in the assemblies of Figures 1 and 2, and

Figure 4 is a perspective view of part of the second seal component shown in Figure 3.

Referring to Figure 1 there is shown the mating ends of two plastics pipe sections, the male end being indicated by the reference numeral 1 and the female end by the reference numeral 2. Figure 2 shows the joint fully made and it will be noted that when the male and female ends are normally interengaged, an annular gap 3 is formed between them, this gap widening to form an enlarged recess 4 in which a two-part sealing arrangement is located. The sealing arrangement comprises a relatively rigid, radially expansible delta ring 5 and a soft, deformable elastomeric ring 6.

The delta ring 5 bears against an end wall 7 of the recess 4 this end wall being formed on the male end and defining a frusto-conical surface which is inclined at an angle θ (see Figure 2) to the plane P which is perpendicular to the axis of the pipe section 1 and passes through the region where the gap 3 first widens to form the recess 4. The delta ring has a base angle of 2θ and is formed from a cut length of delta profile mat rial wrapped once round the male pipe and with the confronting ends of the length adjacent and lightly secured together. It will be noted that the entire end wall 7 lies on the recess side of the plane P.

When pressure rises within the bore of the pipes the elastomeric ring 6 is forced hard against the delta ring 5 which is caused to "ride up" the inclined end wall 7 of the recess to completely close the latter so that although the elastomeric ring is severely deformed by the pressure, there is no possibility of it being extruded further into the gap.

Figures 3 and 4 show in further detail one form of material used for the delta ring 5, this comprising an elastomeric core 10 of filled rubber (e.g. if IRHD number of 70° or above) which incorporates reinforcing wires (or threads) 11 and is wrapped in a fabric carcass 12. The fabric carcass improves the ring's resistance to deformation and, reduces the coefficient of friction existing between the confronting surfaces of the delta ring 5 and the end wall 7.

Figure 4 shows a short length of fabric-wrapped delta ring, the carcass fabric having warp-weft angles of α and β. To ensure adequate stretch of the delta ring in the radial direction it is desirable that α and β approximate to 45°.

In use the pipe lengths can be buried, but in the case of pipe lengths which are not buried, it is known for elastomeric sealing material within the recess to be deleteriously affected by ultra-violet radiation and this is particularly severe in the case of the softer elastomeric materials (e.g. of which the ring 6 would be made). Using a fabric-coated hard elastomer for the delta ring 5 removes any possibility of light affecting the softer elastomeric ring 6 should ultra-violet light pass into the gap 3.

Although a delta ring made from hard elastomeric material is preferred, the use of other materials (e.g. hard plastics or metal) is not ruled out. Where the ring is formed from a wrapped length of material, the confronting faces that form the joint in the delta ring are preferably interengaged (e.g. to define a simple lap joint).

Where the delta ring is made as a complete ring (rather than as a wrapped length of material), the reinforcing wires 11 will not normally be employed. They are optional

even in the case of a wrapped length of material.

The annular seal (6) would typically have an International rubber hardness (IRHD) number of between 50° and 60°.

The invention will be further described by reference to Figure 2 of the drawing and the following Examples.

EXAMPLE 1 (Prior Art)

Two pipe sections of plastics material were joined, the spigot on one pipe section (1) entering the socket on the other (2) to leave a recess (4) in which an O-ring (6) of IRHD number 50° was located. The cross-section diameter of the O-ring was 25.4 mm. On pressurising the interior of the joined pipe sections the O-ring extruded through the three millimetre gap (3) communicating with the recess before the pressure reached 200 lbs/square inch.

EXAMPLE 2

Using the arrangement shown in Figure 2 the same O-ring as used in Example 1 withstood a pressure of 350 lbs/square inch without extrusion through a three millimetre gap (3) when a continuous delta ring (5) of cross-section 22 mm maximum width and 17 mm radial dimension was interposed between the O-ring and the gap (3). The delta ring was made of rubber material of IRHD number 85°. The angle θ in Figure 2 was about 33°.

WHAT WE CLAIM IS:—

1. A reactive (as hereinbefore defined) pipe joint providing a fluid-tight joint in an annular recess defined by a widening of an annular gap located between relatively movable male and female "cylindraceous" (as hereinbefore defined) pipe ends, the outer end of the gap communicating with the space outside the pipe and the recess end of the gap communicating with the bore of the pipe, the joint utilising a seal comprising first and second discrete components, the first component being an annular seal of elastomeric material disposed within the recess and sealingly contacting both the pipe ends, the second seal component being utilised in the recess intermediate the annular seal and an end wall of the recess on the male pipe end which end wall provides said widening of the gap, the second seal component being of a material which is harder than the annular seal and being capable of radial expansion within the recess under the influence of rising pressure in the pipe, the end wall of the recess being inclined to the plane which is perpendicular to the axis of the male pipe end and which passes through the outermost extremity of the recess, the inclination being in the direction such that the entire end wall lies on the recess side of the said plane, whereby radial expansion of the second seal component will arise on a sufficient pressure rise in the pipe by virtue of said second seal component riding up said inclined end wall.

2. A pipe joint as claimed in claim 1, in which the end wall is a frusto-conical surface inclined at an angle of between 10° and 35° to said perpendicular plane.

3. A pipe joint as claimed in claim 1 or claim 2, in which the second seal component is a ring of generally triangular cross-section.

4. A pipe joint as claimed in any preceding claim in which the second seal component is of rubber of IRHD number of 70° or above.

5. A pipe joint as claimed in claim 4 in which the rubber of the second seal is coated with a low friction coefficient material.

6. A pipe joint as claimed in claim 4 or 5, in which the rubber is reinforced with wires or threads.

7. A pipe joint as claimed in any preceding claim in which the second seal component if formed from a wrapped length of strip material, the confronting ends of the length being secured together in a lap joint to form a ring.

8. A pipe joint as claimed in any preceding claim, in which the second seal component is not deleteriously affected by ultra-violet radiation.

9. A pipe joint as claimed in any preceding claim, in which the annular seal is made from a continuous ring of elastomeric material of IRHD number of between 50° and 60°.

10. A pipe joint as claimed in claim 9 in which the annular seal is of circular cross-section.

11. A pipe joint substantially as herein described with reference to and as illustrated in the accompanying drawings.

12. A pipe joint substantially as defined in the foregoing Example 2.

13. A pipe length incorporating at least one pipe joint as claimed in any preceding claim between adjacent pipe sections.

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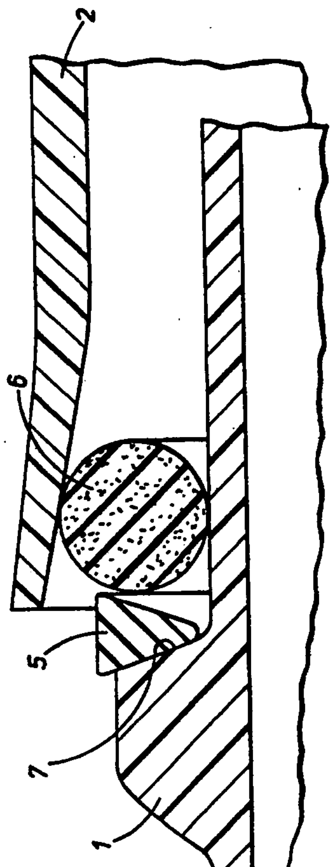

FIG.1.

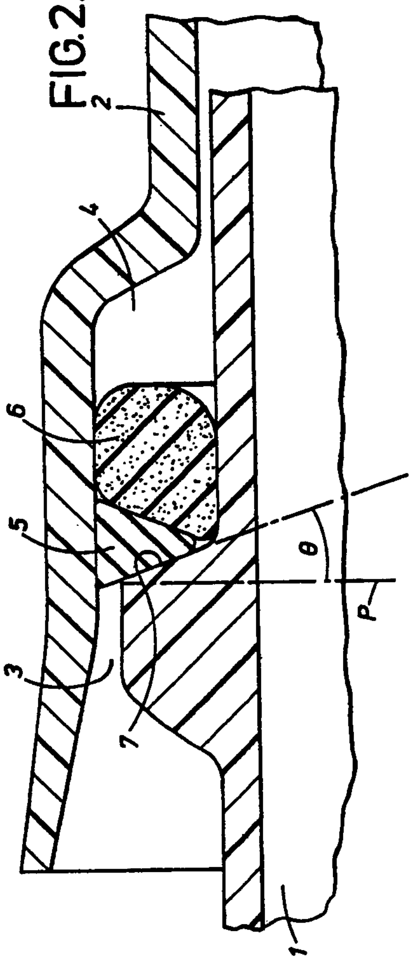

FIG.2.

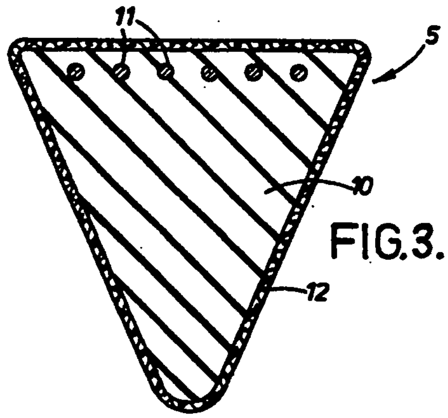

FIG.3.

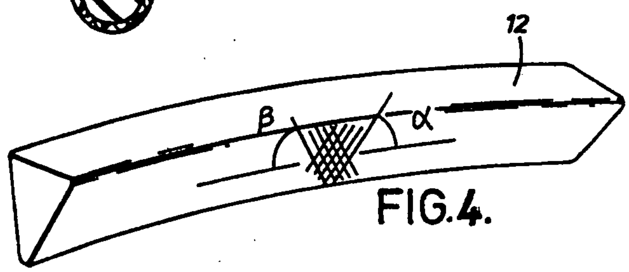

FIG.4.